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Occurrence and distribution of *Melanoplus borealis* (Fieber) as a glacial relict in Nebraska

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Abstract

Bruner (1893) reported *Melanoplus borealis* (Fieber, 1853) as occurring in Nebraska. However, prior to 2007, the species was known from Nebraska by only eight specimens that were all collected prior to 1900. This grasshopper species remained undetected in Nebraska for over a century thereafter. In 2007, a series of *M. borealis* was collected in a wetland area near North Platte, Nebraska . Since 2007, *M. borealis* has been found at several sites across seven Nebraska counties.

Keywords

Glacial relict, grasshopper, Great Plains

Introduction

Melanoplus borealis (Fieber, 1853) is a grasshopper (Orthoptera, Acrididae) with a broad North American distribution but appears mostly limited to cool climates. The recorded distribution extends from Alaska and across most of Canada southward to Pennsylvania, northern Illinois, Nebraska, and southward in the Rocky Mountains into Colorado and Washington to the west (Pfadt 2002, VanDyk 2023, iNaturalist 2024). In southern parts of its range, *M. borealis* is mostly limited to bogs, wet meadows (Hebard 1925), and other cool, moist habitats (Brust et al. 2008).

Until 2007, the only Nebraska records for *M. borealis* were from Bruner (1893). In the Academy of Natural Sciences at Drexel University (ANSP) collection, there were eight Nebraska specimens from prior to 1900. These eight specimens include five from West Point (Cuming County) from July 1888, two specimens from Sioux County from June 1896, and a single specimen from Broken Bow (Custer County) from July 1889.

Melanoplus borealis has remained undetected in Nebraska for over a century (Bruner 1897, Hauke 1953, Hagen and Rabe 1991, Brust et al. 2008). The reasons for this species being undetected in the state for such a long period are unknown, but it may be that although grasshoppers have been surveyed across much of Nebraska in recent decades, these surveys have focused strictly on rangelands. Therefore, habitats such as wetlands have likely been ignored. However, in 2007, a series of eight specimens was collected along Whitehorse Creek, about 10 km (6.5 miles) north of North Platte in Lincoln County (Brust et al. 2008). Whitehorse Creek is a cold, spring-fed creek that likely creates a cool microclimate for some boreal species that live near its banks. In fact, the broad-winged skipper (*Poanes viator* (W. H. Edwards, 1865)) has historically been found along this creek, marking the southwestern-most occurrence of this wetland butterfly in Nebraska (S. M. Spomer, pers. comm.). As this location is in the southern half of Nebraska, *M. borealis* likely occurs at similar locations elsewhere in Nebraska. Since 2007, numerous additional searches have been conducted to locate additional Nebraska populations of *M. borealis*.

Methods

Between 2016 and 2024, surveys were conducted to look for *M. borealis* at potentially suitable locations. Some specimens were collected while surveying for other species, such as various butterflies, in public areas such as state parks, state wildlife areas, state recreation areas, or state historical parks. In other cases, this grasshopper was targeted specifically using satellite and topographic maps to locate areas with high potential on public lands or along roadsides. In 2023, a targeted survey was conducted that also involved obtaining private landowner contact in an attempt to locate undiscovered populations on private land. This process involved a combination of examining satellite maps, using onXmaps, and contacting landowners of potentially suitable areas to obtain permission for access. These sites were surveyed between June 19 and June 29, which appears to be approximately when adults of this species are expected to be most numerous in Nebraska. Specimens were collected with an aerial net and, in some cases, photographed. The collected specimens are deposited in the Chadron State College invertebrate collection.

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Results

Between 2016 and 2024, *M. borealis* was collected at 9 general sites and found at 3 specific localities at one of these sites (Gilbert-Baker Wildlife Management Area (WMA)) and 2 localities at another (Whitehorse Creek). A single male was seen at an additional site (Schlagel Creek WMA), but the specimen evaded capture. In addition to single individual adult specimens found at a few sites, *M. borealis* was found to be numerous at three sites: Cottonwood-Steverson WMA, Bowring Ranch SHP, and Whitehorse Creek. During the targeted study in 2023, *M. borealis* was only found at 4 sites, despite surveying 30 sites during the second half of June. In all of these surveys, numerous photographs were taken of both adult and nymph stages. The immature specimens found at the Agate Fossil Beds National Monument were photographed but not collected. All collected specimens are housed at Chadron State College. In total, *M. borealis* was found in 7 Nebraska counties (Table 1, Fig. 1).

Discussion

Most collections of *M. borealis* in Nebraska have occurred in fen wetlands or along small spring-fed streams or ditches. Fig. 1 includes three examples of wetlands where *M. borealis* was found during this study. The exceptions to this are the three specimens collected at Gilbert-Baker WMA, which were found among woodland openings in a canyon dominated by Ponderosa pine (*Pinus ponderosa* P. & C. Lawson) woodland. These single specimens were found among common snowberry (*Symphoricarpos albus* (L.) S.F. Blake) or creeping Oregon grape (*Berberis repens* (Lindl.) G. Don) and were between 60 and 200 meters from a very small spring-fed stream.

Although attempts were made to determine potential host plant associations for *M. borealis* in Nebraska, no actual feeding was observed. However, two particular plant species tended to be most numerous in areas where this grasshopper was found in large numbers. At Cottonwood-Steverson WMA, *M. borealis* was abun-

Table 1. displays the locations and dates of collection for Nebraska *Melanoplus borealis* collections from 2016–2024.

Nebraska County	Location	Coordinates	Date	Collector	Notes	Map Reference
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	July 26, 2020	M. L. Brust	11 adult specimens collected, 2 of which were photographed	1
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	July 28, 2020	M. L. Brust	14 adult specimens collected, several more photographed	1
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	June 11, 2021	M. L. Brust	3 adult specimens collected, photographed numerous immatures	1
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	June 28, 2021	M. L. Brust	7 adult specimens collected, several more photographed	1
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	July 7, 2021	M. L. Brust	4 adult specimens collected, several more photographed	1
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	June 28, 2022	M. L. Brust	3 adult specimens collected, several more photographed	1
Cherry	27.0 mi. N of Hyannis, Cottonwood-Steverson WMA	42.40651°N, 101.73488°W	July 5, 2024	M. L. Brust	5 males and one female collected (1 male photographed)	1
Cherry	3.0 mi. NNE of Merriman, Bowring Ranch SHP, along ditch	42.95855°N, 101.67304°W	June 28, 2021	M. L. Brust	8 adult specimens collected, several more photographed	2
Cherry	11.7 mi. SSW of Valentine, Schalgel Creek WMA	42.70605°N, 100.6188°W	June 28, 2023	M. L. Brust	One adult male seen but evaded capture	3
Dawes	1.0 mi. SW of Fort Robinson, White River at Ice House Ponds	42.65287°N, 103.47642°W	June 16, 2021	M. L. Brust	1 adult specimen collected	4
Dawes	1.0 mi. SW of Fort Robinson, White River at Ice House Ponds	42.65287°N, 103.47642°W	June 18, 2021	M. L. Brust	2 adult (1 photographed) and 1 immature specimens collected	4
Grant	2.8 mi. NNE ofWhitman, Gudmundsen Ranch	42.07644°N, 101.47894°W	July 8, 2016	M. L. Brust	2 adult specimens collected, 1 of which also photographed	5
Lincoln	Whitehorse Creek, about 6.5 mi. NNW of North Platte	41.22561°N, 100.79221°W	June 28, 2023	M. L. Brust	16 adult specimens collected, several more photogrpahed, likely over 100 seen	6
Lincoln	Whitehorse Creek, about 7.0 mi. NNW of North Platte	41.22922°N, 100.79488°W	June 28, 2023	M. L. Brust	6 adult specimens collected and photographed, several more seen	6
Sheridan	25.0 mi. S of Rushville, Smith Lake, N side, along creek	42.41576°N, 102.46157°W	June 20, 2021	M. L. Brust	1 adult specimen collected	7
Sheridan	28.9 mi. NNE of Allaince	42.47506°N, 102.61582°W	July 21, 2022	A. Erthum	2 adult specimens collected in USDA sweep sample	8
Sioux	5.5 mi. N of Harrison, Monroe Canyon (Gilbert-Baker WMA), about 0.5 mi. below pines	42.75613°N, 103.93522°W	July 2, 2022	M. L. Brust	1 adult specimen collected and photographed	9
Sioux	5.5 mi. N of Harrison, Monroe Canyon (Gilbert-Baker WMA), highest meadow before pines	42.75413°N, 103.9374°W	July 2, 2022	M. L. Brust	1 adult specimen collected and photographed	9
Sioux	5.5 mi. N of Harrison, Monroe Canyon (Gilbert-Baker WMA)	approx. 42.75573°N, 103.93446°W	July 7, 2022	M. L. Brust	1 adult specimen collected and photographed	9
Sioux	Agate Fossil Beds National Monument, 1st service road east of headquarters	42.4222°N, 103.74639°W	June 19, 2023	M. L. Brust	Two immatures photographed	10
Sioux	8.9 mi. WSW of Harrison, Niobrara River off Henry Rd.	42.65248°N, 104.05126°W	July 19, 2024	M. L. Brust	3 males collected (1 photographed)	11
Thomas	2.0 mi. W of Thedford, Middle Loup River off Hwy. 20	41.97962°N, 100.62038°W	July 10, 2024	M. L. Brust	3 males collected (1 photographed)	12

dant among patches of pale smartweed (*Persicaria lapathifolia* L.), especially within 50 meters of the ditch to the west of Steverson Lake. Occasional individuals turned up among giant goldenrod (*Solidago gigantea* Ait.) further from the ditch as well as in wetland areas near the southwest end of Steverson Lake. At Bowring Ranch State Historic Park (SHP,) this grasshopper was found almost exclusively among patches of *P. lapathifolia* along a ditch about 300 meters east of the Bowring Ranch Visitor Center. At Fort Robinson State Park, 2 of the three adult specimens and the single immature specimen were found among small stands of *P. lapathifolia*, with the other specimen found among smooth brome (*Bromus inermis* Leyss.) within 30 meters of *P. lapathifolia*. The single collected adult and several observed nymphs (immatures) found at Smith Lake were found among patches of *P. lapathifolia*. *Persicaria lapathifolia* was also numerous at Gudmundsen Ranch in the area where *M. borealis* was found. At Whitehorse Creek, this grasshopper was abundant among patches of *S. gigantea*, and some *P. lapathifolia* was noted to be present there. The nymph specimens found at the Agate Fossil Beds National Monument were found among *S. gigantea*. It is also worth noting that, with the exception of Schlagel Creek WMA where a single individual was observed, all sites appeared to have no evidence of recent grazing. The Schlagel

Fig. 1. Examples of wetland habitats where *M. borealis* was found during this study; **A.** 2 miles west of Thedford, Nebraska, photographed on July 10, 2024; **B.** White River at the Ice House Ponds in Fort Robinson State Par, west of Crawford, Nebraska, photographed on June 23, 2025; **C.**. Cottonwood-Steverson WMA about 27 miles (43 km) north of Hyannis, Nebraska, photographed on July 26, 2020.

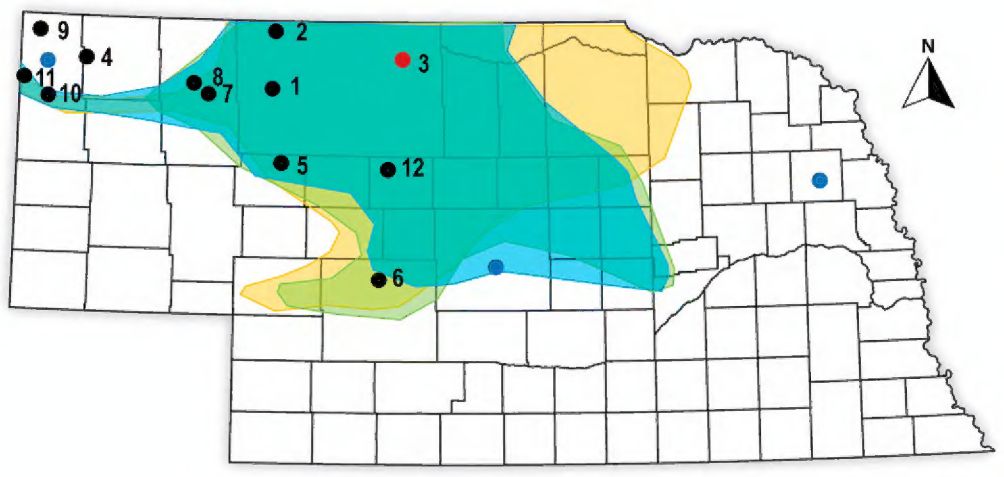

Fig. 2. Known Nebraska distribution of *M. borealis* in 2024. Black dots indicate either collected (in most cases) or photographed specimens (Agate Fossil Beds NM). Red dot indicates a sighting but no voucher specimen or photograph. Blue dots indicate pre-1900 records from Bruner. Colored areas represents the general distribution of each of the following fish species in Nebraska; yellow = northern redbelly dace (*Chrosomus eos*), green = finescale dace (*Chrosomus neogaeus*) , and blue = northern pearl dace (*Margariscus margarita*) (drawn from Hrabik et al. 2015).

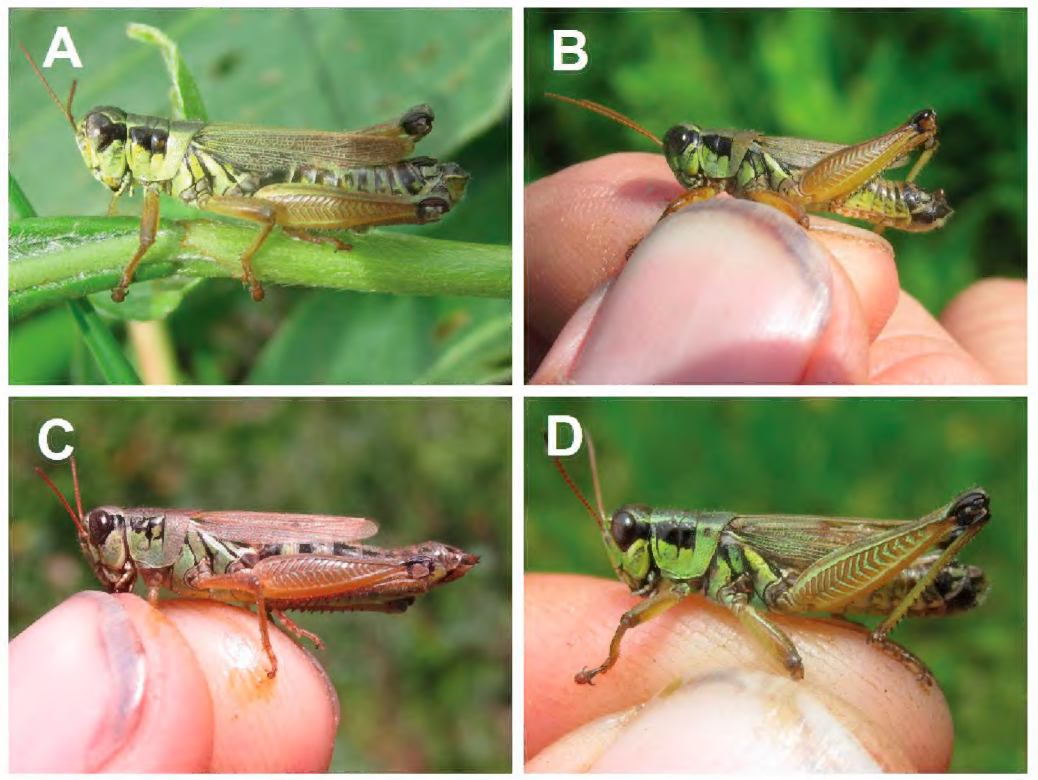

Fig. 3. Comparison of Nebraska *M. borealis* with *M. borealis* from the South Dakota Black Hills; **A.** Male from Cottonwood-Steverson WMA in Cherry County, NE on July 28, 2020; **B.** Male from Whitehorse Creek in Lincoln County, NE on June 28, 2023; **C.** Female from Gilbert-Baker WMA (Monroe Canyon) in Sioux County, NE on July 7, 2022; **D.** Male from Ditch Creek Road in Pennington County, SD on July 25, 2020.

Creek WMA site was heavily grazed at the time of the survey, and the habitat looked severely degraded with little forb or shrub growth near Schagel Creek other than *S. albus* and some *S. gigantea* along the steep creek banks.

Evidence suggests that the populations of *M. borealis* in Nebraska, as well as perhaps the Black Hills of South Dakota, represent glacial relict populations and have likely been isolated from other *M. borealis* populations for a significant amount of time. In particular, the currently known distribution of *M. borealis* correlates well with the distributions of three Nebraska fish species that are considered glacial relicts (Lee et al. 1980, Hrabic et al. 2015): northern redbelly dace (*Chrosomus eos* Cope), finescale dace (*Chrosomus neogaeus* (Cope)), and northern pearl dace (*Margariscus margarita* Cope) (Fig. 2). Over 50% of the recorded locations for *M. borealis* fall within the general Nebraska distribution of all three of these fish species. It is also worth noting that the distribution of *M. borealis* includes the two westernmost records for the broad-winged skipper (*Poanes viator*) in Nebraska at Smith Lake and at Whitehorse Creek (S. M. Spomer, pers. comm.). In addition, Kaul et al. (1988) described the Niobrara River Valley in Nebraska as a postglacial refugium for a variety of plant and animal species, and *M. borealis* was collected at several sites near the Niobrara River Valley during this study. Steinauer et al. (1996) noted several plant species considered glacial relicts found in wetland fens in the Nebraska Sandhills, and these sites and habitats also overlap with *M. borealis*.

As the Nebraska *M. borealis* populations are likely geographically isolated, genetic analyses might reveal their relationship with other North American populations. Morphologically, the Nebraska populations appear indistinguishable from those of the South Dakota Black Hills (Fig. 3). However, the Nebraska and South Dakota Black Hills populations appear to differ morphologically from populations in Colorado and Canada.

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